CLAIMS

What is Claimed is:

Sub 7 a1

1. A microelectronic spring structure, comprising:

a base formed of a resilient material;

a beam formed integrally with said base of said resilient material, and connected to said base at a first end of said beam; and

a tip positioned at a second end of said beam opposite to said base;

wherein said beam has an unsupported span between said tip and said base.

2. The microelectronic spring structure of Claim 1, further comprising a substrate attached at a surface thereof to said base.

3. The microelectronic spring structure of Claim 2, wherein said tip has an unloaded height over the plane of said substrate surface in the range of 1 to 5 mils.

4. The microelectronic spring structure of Claim 3, wherein said tip has an unloaded height over the plane of said substrate surface less than about 2 mils.

5. The microelectronic spring structure of Claim 1, wherein said beam has a width in the range of about 6 to 12 mils.

6. The microelectronic spring structure of Claim 1, wherein said beam has a width no greater than 5 mils at said base.

Sub 7 a2

7. The microelectronic spring structure of Claim 6, wherein said beam has a width less than about 1 mils.

8. The microelectronic spring structure of Claim 1, wherein said beam has a length in the range of about 1 to 10 mils.

Sub C3

9. The microelectronic spring structure of Claim 1, wherein said beam has a substantially uniform thickness.

10. The microelectronic spring structure of Claim 1, wherein said beam has a thickness in the range of about 0.4 to 20 mils.

11. The microelectronic spring structure of Claim 1, wherein said beam has a thickness less than 0.4 mils.

12. The microelectronic spring structure of Claim 11, wherein said beam, as measured at any representative cross-section taken across a width of said beam along at least a portion of the length of said beam, has an area moment of inertia substantially greater than said width multiplied by the cube of said thickness, divided by twelve.

13. The microelectronic spring structure of Claim 2, wherein said microelectronic spring structure has an elastic deflection ratio in a direction perpendicular to and towards said substrate surface of at least 10%.

14. The microelectronic spring structure of Claim 2, wherein said microelectronic spring structure has an elastic range in a direction perpendicular to and towards said substrate surface within a range of about one to twenty mils.

15. The microelectronic spring structure of Claim 14, having an elastic range of at least four mils, measured at said tip in a direction perpendicular to said substrate surface.

16. The microelectronic spring structure of Claim 2, wherein said microelectronic spring structure has a spring rate at said tip in at least one direction of at least thirty micrograms per micron.

17. The microelectronic spring structure of Claim 16, wherein said microelectronic spring structure has a spring rate at said tip in at least one direction within a range of about 30 to 600 micrograms per micron.

18. The microelectronic spring structure of Claim 1, wherein said beam is contoured.

19. The microelectronic spring structure of Claim 1, wherein said beam is contoured in a lengthwise direction.

Sub a4

20. The microelectronic spring structure of Claim 1, wherein said beam is contoured in a widthwise direction.

21. The microelectronic spring structure of Claim 1, wherein said beam is generally V-shaped in cross-section.

22. The microelectronic spring structure of Claim 1, wherein said beam is generally U-shaped in cross-section.

23. The microelectronic spring structure of Claim 1, wherein said beam is generally S-shaped in a lengthwise direction.

24. The microelectronic spring structure of Claim 1, wherein said beam further comprises corrugations disposed along a lengthwise direction.

25. The microelectronic spring structure of Claim 2, wherein said beam, in a lengthwise sectional view, has a stepped portion connected to said base.

Sub a5

26. The microelectronic spring structure of Claim 26, wherein said stepped portion of said beam has a step height in the range about 5% to 20% of an unloaded height of said tip over said substrate surface.

27. The microelectronic spring structure of Claim 26, wherein said stepped portion of said body portion has a step height about 10% of an unloaded height of said tip over said substrate surface.

28. The microelectronic spring structure of Claim 1, wherein said beam further comprises a plurality of lengthwise ribs extending over at least a portion of said beam.

29. The microelectronic spring structure of Claim 1, wherein said beam further comprises a lengthwise rib extending over at least a portion of said beam.

30. The microelectronic spring structure of Claim 29, wherein said beam has a stepped portion connected to said base, and wherein said lengthwise rib extends to said stepped portion.

31. The microelectronic spring structure of Claim 29, wherein said lengthwise rib extends into said base.

32. The microelectronic spring structure of Claim 29, wherein said lengthwise rib comprises a lengthwise channel.

33. The microelectronic spring structure of Claim 29, wherein said lengthwise channel has a regular geometric cross-sectional shape.

34. The microelectronic spring structure of Claim 33, wherein said regular geometric cross-sectional shape further comprises a shape selected from the group consisting of part-rectangular, part-trapezoidal, part-triangular and part-round shapes.

35. The microelectronic spring structure of Claim 29, wherein said a cross-sectional dimension of said lengthwise rib differs over the length thereof.

36. The microelectronic spring structure of Claim 29, wherein said rib is comprised of a folded portion of said beam.

37. The microelectronic spring structure of Claim 1, wherein said beam has a plurality of ribs along a lengthwise direction, wherein said plurality of ribs have a height tapering from a first dimension at said base to a second dimension at said tip, wherein said first dimension is greater than said second dimension.

38. The microelectronic spring structure of Claim 2, wherein said spring structure comprises a sheet of resilient material, wherein said sheet, viewed from above

said spring structure in a direction normal to said substrate, is essentially free of any overlapping portion.

39. The microelectronic spring structure of Claim 38, wherein said sheet of resilient material comprises a homogenous layer of essentially uniform thickness.

40. The microelectronic spring structure of Claim 38, wherein said sheet of resilient material is contoured in at least a portion thereof.

41. The microelectronic spring structure of Claim 2, wherein said beam, viewed in a direction normal to said substrate surface, is tapered so as to have a generally triangular shape.

42. The microelectronic spring structure of Claim 2, wherein said beam, viewed in a direction normal to said substrate surface, has a generally rectangular shape.

43. The microelectronic spring structure of Claim 2, wherein said beam, viewed in a direction normal to said substrate surface, has an offset with respect to a central axis.

44. The microelectronic spring structure of Claim 2, wherein said beam, viewed in a direction normal to said substrate surface, is contoured so that said tip is positioned a distance from said base that is less than an integrated length of said beam between said base and said tip.

45. The microelectronic spring structure of Claim 2, wherein said beam, viewed in a direction normal to said substrate surface, is serpentine.

46. The microelectronic spring structure of Claim 2, wherein said beam, viewed in a direction normal to said substrate surface, is C-shaped.

47. The microelectronic spring structure of Claim 44, wherein a portion of said beam comprises at least two parallel arms.

48. The microelectronic spring structure of Claim 1, wherein said resilient material comprises a metallic material.

49. The microelectronic spring structure of Claim 48, wherein said metallic material comprises a material selected from the group consisting of: nickel, and alloys thereof; copper, cobalt, and iron, and alloys thereof; gold and silver; elements of the platinum group; noble metals; semi-noble metals and alloys thereof, particularly elements of the palladium group and alloys thereof; and refractory metals and alloys thereof, particularly tungsten and molybdenum and alloys thereof; tin, lead, bismuth, indium and gallium and alloys thereof.

50. The microelectronic spring structure of Claim 1, wherein said resilient material comprises a laminate of a conductive material and an insulating material.

51. The microelectronic spring structure of Claim 1, wherein said resilient material comprises a layer of an electrically conductive seed material and a layer of electroplated metallic material.

52. The microelectronic spring structure of Claim 51, wherein said seed material comprises layers of one or more metals selected from the group consisting of titanium, chromium, gold, copper, palladium, tungsten and silver, and alloys thereof.

53. The microelectronic spring structure of Claim 51, wherein said layer of electrically conductive seed material comprises Au and has a thickness in the range about 100 to 1000 Å.

54. The microelectronic spring structure of Claim 51, wherein said seed layer comprises a Ti-W alloy and has a thickness in the range about 100 to 1000 Å.

55. The microelectronic spring structure of Claim 51, wherein said seed layer comprises Cu and has a thickness in the range about 1000 to 3000 Å.

56. The microelectronic spring structure of Claim 2, wherein said base is affixed in electrically-conductive relation to a contact structure in said substrate.

57. The microelectronic spring structure of Claim 56, wherein at least a portion of said contact structure in said substrate is covered by an electrically conductive layer.

58. The microelectronic spring structure of Claim 2, wherein at least a portion of said substrate at said surface is electrically conductive.

59. The microelectronic spring structure of Claim 2, wherein said substrate surface comprises a surface of an electrically conductive layer.

60. The microelectronic spring structure of Claim 59, wherein said electrically conductive layer comprises an Ti-W alloy.

61. The microelectronic spring structure of Claim 59, wherein said electrically conductive layer comprises a bi-layer structure comprising a first layer of Cr and a second layer of Au.

62. The microelectronic spring structure of Claim 59, wherein said electrically conductive layer comprises a bi-layer structure comprising a first layer of Ti and a second layer of Au.

63. The microelectronic spring structure of Claim 59, wherein said electrically conductive layer has a thickness in the range of about 3000 to 6000 Å.

64. The microelectronic spring structure of Claim 59, wherein said electrically conductive layer has a thickness of about 4500 Å.

65. The microelectronic spring structure of Claim 1, further comprising a conducting tip assembly, said conducting tip assembly comprising a plurality of

conducting tips selected from the group consisting of: a pointed tip, a spade tip, a spherical tip, a pyramidal tip, a flat tip, and a rounded tip.

66. A conducting tip assembly for a microelectronic spring structure, comprising a plurality of conducting tips selected from the group consisting of: a pointed tip, a spade tip, a spherical tip, a pyramidal tip, a flat tip, and a rounded tip.

67. The conducting tip assembly of Claim 66, wherein at least two of said plurality of conducting tips are connected to separate arms of a microelectronic spring structure.

68. The conducting tip assembly of Claim 66, wherein at least two of said plurality of conducting tips are connected to each other on a single arm of a microelectronic spring structure.

69. The microelectronic spring structure of Claim 1, further comprising a second beam and a second base, said second beam formed integrally of said resilient material, wherein said second beam is connected to said beam at said second end of said beam.

70. The microelectronic spring structure of Claim 1, further comprising a second beam, said second beam formed integrally with said base of said resilient material and connected to said base at a first end, and a second tip positioned at a second end of said second beam opposite to said base.